This PDF file is an excerpt from the EPA sampling report entitled *Sampling Episode Report - Holland America Veendam - Sampling Episode 6503* (March 2006). The full report can be downloaded from http://www.epa.gov/owow/oceans/cruise_ships/veendam.html

Sampling Episode Report
Holland America Veendam
Sampling Episode 6503

Chapter 5
Data Quality

March 2006

5.0 DATA QUALITY

Quality assurance/quality control (QA/QC) procedures applicable to the Veendam sampling episode are outlined in the *Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Waters (QAPP)*, which is included in the Cruise Ship Rulemaking Record and is available upon request. This section describes the quality control practices used to assess the precision and accuracy of the analytical data presented in Section 4.0. Quality control (QC) practices used for this sampling episode include the analysis of matrix spikes, duplicate samples, and quality control standard checks.

5.1 Analytical Quality Control

EPA verified that laboratory performance was acceptable by conductig quality checks of the analytical data as specified by the QAPP. Data review chemists prepared written data review narratives (Appendix D) describing any qualifications of the analytical data. The following data were not considered to be of acceptable quality for the reasons discussed in Appendix D and were excluded from the data set:

- Three pesticides:
  - Norflurazon in samples 65215, 65227, and 65240,
  - Ancephate in sample 65227, and
  - Kepone in sample 65240.

- One pathogen indicator:
  - Enterococci in sample 65262.

- Four semivolatile organics:
  - Benzidine for all samples, and
  - 4-Nitrophenol, pentachlorophenol, and hexachlorocyclopentadiene in sample 65293.

5.1.1 Cyanide Results

There was uncertainty regarding the analytical results for available and total cyanide. Although these data have not been excluded from the database, the results are presented in Table 5-1 and not in the analytical results summary tables in Section 4.1. Available cyanide was detected in many samples, while total cyanide was not detected in these samples. In theory, the total cyanide results for any given sample will be greater than the available cyanide results in the same sample. Further investigation identified multiple issues with sample collection and analysis that may have led to the irreconcilable results for total and available cyanide in these samples, including poor matrix spike/matrix spike duplicate recoveries for total cyanide, lack of treatment to remove sulfides interferences for some samples, and poor agreement of duplicate sample results (see memoranda *Data Review Narrative for Classical Analyses for the Alaska Cruise Ship Industry Episode 6503* and *Issues Associated with Results for Total Cyanide Versus Available Cyanide* in Appendix D for a complete discussion). Because it was not possible to determine which analysis was correct, EPA flagged the irreconcilable results in the database to alert data users to the presence of such problems.

EPA did not identify any known source of cyanide onboard the Veendam during its onboard interviews regarding activities that impact wastewater generation.

5.1.2 Mercury Results

There was expressed uncertainty regarding the analytical results for total and dissolved mercury because these analytes were detected in a laboratory blank at concentrations greater than the method detection limit (MDL). See data review narrative for total and dissolved metals analyses in Appendix D for a complete discussion. Although other metals analytes were detected in laboratory blanks at concentrations greater than the MDL, total mercury was the only

analyte that was detected in the treatment effluent above one or more water quality criteria/standards.

5.2 Field Quality Control

The trip blank, equipment blank, and field duplicate results are the field QA/QC measures discussed in this subsection. Section 3.8 of the Veendam SAP discusses field QC specifications. Tables presented in this section of this document include results for only those analytes detected in the field QC samples during the sampling episode. Appendices A-1 and A-2 contain the results for all analytes, both detected and nondetected.

5.2.1 Trip Blank

A trip blank was collected and analyzed for volatile organics to evaluate possible contamination during shipment and handling of samples. This sample consisted of high performance liquid chromatography (HPLC) water. The trip blank was prepared prior to the start of the sampling episode, and accompanied samples shipped to the laboratory on June 25, 2004.

No volatile organics were detected in the trip blank, indicating that there was no contamination of samples during transport, field handling, storage, or shipping. (Note that there is no table with the results of the analyses in this section of the report because all results are nondetects.)

5.2.2 Equipment Blank

The sampling team collected an equipment blank to assess the potential introduction of contaminants by sample collection equipment. The sample collection equipment used to collect the equipment blank was the same as that used at the sampling points: approximately 4 feet of Teflon® tubing connected on one end to a series of metal plumbing fixtures installed on each sample port, and the other end to a small segment of silicone tubing

used in the peristaltic pump mechanism of the automatic sampler. The equipment blank was collected by pumping HPLC water through this equipment directly into sample bottles.

Table 5-2 presents the detected results for the equipment blank. Nine total metals and 11 dissolved metals were detected in the equipment blank. Table 5-2 also includes a value for hardness (a classical analyte), which was calculated based on the total magnesium and calcium concentrations detected in the sample using Standard Method 2340B. In tables presenting the analytical results in Section 4.1, all 20 of these metal analytes and hardness are flagged with an "(e)" to indicate they were detected in the equipment blank. EPA will consider the impact of possible contamination from sampling equipment in a future analysis.

5.2.3 Field Duplicates

Field duplicate samples were collected to assess the precision of the entire sample collection, handling, preparation, and analysis process. The relative percent difference (RPD) between the two duplicate sample results is calculated and compared to the data quality objective. For this program, the QAPP provides an RPD target for field duplicate samples as less than 30% for all analytes of a specific analytical method.

Classical Pollutants (Except HEM/SGT-HEM), Total and Dissolved Metals, and Semivolatile Organics

For classical pollutants (except HEM/SGT-HEM), total and dissolved metals, and semivolatile organics, field duplicate samples were samples collected from the same source, at the same time, then stored and analyzed independently. The duplicate samples were collected as split samples poured from the same mixed sample composite jars to minimize sample wastestream variability. Duplicate samples for these analytes were collected from the effluent from the wastewater treatment system (SP-9/10), except for the following: duplicate samples for dioxins and furans analytes were collected from the laundry graywater (SP-1/2), and duplicate samples for pesticides analytes were collected from the influent to the wastewater treatment system (SP-6/7).

Table 5-3 presents analytical results and the RPDs for these duplicate samples and includes analytical results for only those analytes that were detected at least once in wastewater samples (i.e., graywater sources, influent to treatment system, or effluent from treatment system) during the sampling episode. Duplicate sample results for pesticides and dioxins and furans are not shown in Table 5-3 because these analytes were not detected in any wastewater samples during the sampling episode, including these duplicate samples.

There was excellent precision in sampling and analysis for this sampling episode. Of the 134 duplicate pairs listed in Table 5-3, 122 either achieved the RPD target, or the RPD could not be calculated because both of the duplicate samples were less than the detection limit. The RPD could not be calculated for 9 of the duplicate pairs because the analyte was detected in one sample but not the other. Analytical variability increases as analyte concentrations approach their detection limits. The three duplicate pairs with an RPD outside of the target (i.e., $\geq$30% difference) include one of two duplicate pairs for each of aluminum, dissolved mercury, and total Kjeldahl nitrogen. These results are not uncommon in complex wastewater samples.

In tables presenting the analytical results in Section 4.1, duplicate sample results are presented as averages (calculation uses detection limits for nondetected results).

Pathogen Indicators, HEM/SGT-HEM, Volatile Organics, and Dioxins and Furans in Incinerator Ash

For pathogen indicators, HEM/SGT-HEM, volatile organics, and dioxins and furans in incinerator ash, field duplicate samples were collected sequentially and not as split samples as was done for the other analytes. For these samples, this methodology introduced sample wastestream variability into the assessment of the precision of sample collection and analysis. Duplicate samples for these analytes were collected from the effluent from the treatment system (SP-9/10), except for the following: one duplicate sample pair for pathogen indicators and two duplicate sample pairs for HEM/SGT-HEM were collected from the influent to the treatment system (SP-6/7), and one duplicate sample pair for pathogen indicators was collected from the influent to UV disinfection (SP-8). Duplicate samples for dioxins and furans were collected from the incinerator ash (SP-13/14). As discussed in Section 3.6, collection and

analysis of duplicate samples for analysis of HEM/SGT-HEM is a deviation from the Veendam SAP. In addition, collection and analysis of pathogen indicators duplicate samples at sampling locations other than the effluent from the treatment system (SP-9/10) was also a deviation from the Veendam SAP (see Section 3.6). Table 5-4 presents analytical results and the RPDs for these duplicate samples.

The RPD target of less than 30% may not be appropriate for these duplicate samples because the wastestreams are expected to be variable. As shown in Table 5-4, for influent to treatment and influent to UV disinfection wastewaters, 5 of the 10 duplicate sample pairs had RPDs greater than 30%. Of the 37 duplicate sample pairs listed in Table 5-4 for the effluent from treatment, one achieved the QAPP-specified RPD target, and for 33, the RPD could not be calculated because both of the duplicate samples was less than the detection limit. The RPD could not be calculated for one of the duplicate pairs because the analyte was detected in one sample but not the other. The two sample pairs with an RPD outside of the target (i.e., $\geq$30% difference) were for tetrachloroethene. For incinerator ash samples, 12 of the 17 duplicate sample pairs had RPDs greater than 30%.

In tables presenting the analytical results in Section 4.1, duplicate sample results are presented as averages (calculation uses detection limits for nondetected results). In the case of pathogen indicators, average daily results presented incorporate both duplicate grab samples and multiple grab samples collected for individual analysis during each 24-hour sampling period. First, duplicate results, where applicable, were averaged to determine the average individual grab sample results for that sample (e.g., grab 1 duplicate sample results for Day 3 were averaged together to represent the average grab 1 sample result for Day 3). Next, the individual grab sample results for each day were averaged to calculate the average daily pathogen indicators results presented in the tables (e.g., grab sample results 1 through 3 for Day 3 were averaged together to calculate the average Day 3 pathogen indicators sample results). In this way, the average daily pathogen indicators results presented in the tables are weighted equally by time of day, rather than weighted more heavily by the particular time of day when duplicate grab samples were collected.

Table 5-1

Available and Total Cyanide Analytical Results, Holland America Veendam

Available and total cyanide analytical results are irreconcilable; see Section 5.1.1.

Waste Stream	Available Cyanide (ug/L)	Total Cyanide (ug/L)
Laundry (SP-1)	ND(2.00)	ND(5.00)
Accommodations (SP-3)	15.7	ND(5.00)
Food Pulper (SP-4)	88.4	14.0
Galley (SP-5)	ND(2.00)	ND(5.00)
Influent to Treatment (SP-6), Day 1	10.4	ND(5.00)
Influent to Treatment (SP-6), Day 2	ND(2.00)	ND(5.00)
Influent to Treatment (SP-6), Day 3	7.54	ND(5.00)
Influent to Treatment (SP-6), Day 4	35.4	ND(5.00)
Influent to Treatment (SP-6), Day 5	16.0	ND(5.00)
Effluent from Treatment (SP-9), Day 1	< 5.48	ND(5.00)
Effluent from Treatment (SP-9), Day 2	< 3.93	ND(5.00)
Effluent from Treatment (SP-9), Day 3	ND(2.00)	ND(5.00)
Effluent from Treatment (SP-9), Day 4	ND(2.00)	ND(5.00)
Effluent from Treatment (SP-9), Day 5	2.01	ND(5.00)
Screening Solids (SP-11)	ND(2.00)	ND(5.00)
Biosludge (SP-12)	ND(2.00)	ND(5.00)
Source Water (SP-15)	19.1	ND(5.00)

< - Average result includes at least one nondetect value (calculation uses detection limits for nondetect results).
ND - Not detected (number in parentheses is detection limit).

Table 5-2

Equipment Blank Analytical Results, Holland America Veendam

Analytical results for analytes detected in the equipment blank. See Appendix A-2 for all analytical results (detected and nondetected). The equipment blank was collected as a one-time grab sample. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Equipment Blank (SP-17)
Classical Pollutants			
Hardness	mg/L		0.170
Total and Dissolved Metals			
Barium, Total	ug/L		8.00
Calcium, Total	ug/L		58.2
Copper, Total	ug/L	P120	23.5
Iron, Total	ug/L		191
Lead, Total	ug/L	P122	27.8
Manganese, Total	ug/L		5.20
Sodium, Total	ug/L		197
Titanium, Total	ug/L		0.440
Zinc, Total	ug/L	P128	256
Aluminum, Dissolved	ug/L		406
Barium, Dissolved	ug/L		21.2
Calcium, Dissolved	ug/L		53.2
Copper, Dissolved	ug/L	P120	3.10
Iron, Dissolved	ug/L		35.1
Lead, Dissolved	ug/L	P122	77.2
Magnesium, Dissolved	ug/L		12.4
Manganese, Dissolved	ug/L		5.80
Sodium, Dissolved	ug/L		260
Titanium, Dissolved	ug/L		0.960
Zinc, Dissolved	ug/L	P128	46.5

Table 5-3

Field Duplicate Analytical Results for Classical Pollutants (Except HEM/SGT-HEM), Total and Dissolved Metals, and Semivolatile Organics, Holland America Veendam

Field duplicate analytical results for classical pollutants (except HEM/SGT-HEM), total and dissolved metals, and semivolatile organics, detected at least once in wastewater samples during the sampling episode. See Appendix A-2 for all field duplicate analytical results (detected and nondetected). Field duplicate samples for these analytes are split samples collected from the same source, at the same time, stored and analyzed independently. Results for duplicate samples for pesticides from the influent to treatment (SP-6/7) and dioxins and furans from the laundry wastewater (SP-1/2) are not presented in this table as these analytes were not detected in these samples. See Figure 2-2 for the sampling point locations. Also listed are the average result and relative percent difference calculated for each duplicate pair. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Classical Pollutants								
Alkalinity (s)	mg/L		65261	65281	222	222	222	0.0
Alkalinity (s)	mg/L		65265	65283	261	269	265	3.0
Ammonia As Nitrogen (NH3-N) (s)	mg/L		65261	65281	11.0	11.0	11.0	0.0
Ammonia As Nitrogen (NH3-N) (s)	mg/L		65277	65289	29.0	29.0	29.0	0.0
Available Cyanide (s)	ug/L	P121	65261	65281	ND(2.00)	8.96	< 5.48	NC
Available Cyanide (s)	ug/L	P121	65265	65283	5.86	ND(2.00)	< 3.93	NC
Biochemical Oxygen Demand (BOD_5)	mg/L		65269	65285	ND(2.00)	ND(2.00)	ND(2.00)	NC
Biochemical Oxygen Demand (BOD_5)	mg/L		65277	65289	2.24	2.49	2.37	11
Chemical Oxygen Demand (COD)	mg/L		65261	65281	34.0	33.0	33.5	3.0
Chemical Oxygen Demand (COD)	mg/L		65277	65289	39.0	46.0	42.5	16

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Chloride (s)	mg/L		65261	65281	60.0	62.0	61.0	3.3
Chloride (s)	mg/L		65265	65283	68.0	66.0	67.0	3.0
Hardness (e) (s)	mg/L		65261	65281	24.4	24.0	24.2	1.7
Hardness (e) (s)	mg/L		65269	65285	40.4	40.7	40.6	0.74
Nitrate/Nitrite (NO2-N + NO3-N) (s)	mg/L		65261	65281	ND(0.050)	ND(0.050)	ND(0.050)	NC
Nitrate/Nitrite (NO2-N + NO3-N) (s)	mg/L		65277	65289	ND(0.050)	ND(0.050)	ND(0.050)	NC
Settleable Residue	mL/L		65273	65287	ND(0.110)	ND(0.110)	ND(0.110)	NC
Settleable Residue	mL/L		65277	65289	1.00	ND(0.11)	< 0.555	NC
Sulfate (s)	mg/L		65261	65281	ND(3.00)	ND(3.00)	ND(3.00)	NC
Sulfate (s)	mg/L		65265	65283	4.00	4.00	4.00	0.0
Total Cyanide	mg/L	P121	65261	65281	ND(0.005)	ND(0.005)	ND(0.005)	NC
Total Cyanide	mg/L	P121	65265	65283	ND(0.005)	ND(0.005)	ND(0.005)	NC
Total Dissolved Solids (TDS) (s)	mg/L		65261	65281	323	324	324	0.31
Total Dissolved Solids (TDS) (s)	mg/L		65265	65283	385	386	386	0.26
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		65261	65281	12.0	56.0	34.0	130
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		65277	65289	29.0	28.0	28.5	3.5
Total Organic Carbon (TOC)	mg/L		65261	65281	13.0	12.0	12.5	8.0
Total Organic Carbon (TOC)	mg/L		65277	65289	14.0	12.0	13.0	15

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Total Phosphorus	mg/L		65261	65281	0.210	0.170	0.190	21
Total Phosphorus	mg/L		65277	65289	7.00	8.00	7.50	13
Total Suspended Solids (TSS)	mg/L		65261	65281	ND(5.00)	ND(5.00)	ND(5.00)	NC
Total Suspended Solids (TSS)	mg/L		65265	65283	ND(5.00)	ND(5.00)	ND(5.00)	NC
Total and Dissolved Metals								
Aluminum, Total	ug/L		65261	65281	36.8	29.4	33.1	22
Aluminum, Total	ug/L		65269	65285	28.4	63.9	46.2	77
Aluminum, Dissolved (e) (s)	ug/L		65261	65281	33.1	36.2	34.7	8.9
Aluminum, Dissolved (e) (s)	ug/L		65269	65285	34.3	40.0	37.2	15
Antimony, Total	ug/L	P114	65261	65281	ND(5.97)	ND(5.97)	ND(5.97)	NC
Antimony, Total	ug/L	P114	65269	65285	ND(5.97)	ND(5.97)	ND(5.97)	NC
Arsenic, Total	ug/L	P115	65261	65281	ND(2.32)	ND(2.32)	ND(2.32)	NC
Arsenic, Total	ug/L	P115	65269	65285	ND(2.32)	ND(2.32)	ND(2.32)	NC
Arsenic, Dissolved	ug/L	P115	65261	65281	ND(2.32)	ND(2.32)	ND(2.32)	NC
Arsenic, Dissolved	ug/L	P115	65269	65285	ND(2.32)	ND(2.32)	ND(2.32)	NC
Barium, Total (e) (s)	ug/L		65261	65281	16.2	15.8	16.0	2.5
Barium, Total (e) (s)	ug/L		65269	65285	25.7	25.8	25.8	0.39
Barium, Dissolved (e) (s)	ug/L		65261	65281	15.4	15.7	15.6	1.9
Barium, Dissolved (e) (s)	ug/L		65269	65285	26.3	25.2	25.8	4.3

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Beryllium, Total	ug/L	P117	65261	65281	ND(0.054)	ND(0.054)	ND(0.054)	NC
Beryllium, Total	ug/L	P117	65269	65285	ND(0.054)	ND(0.054)	ND(0.054)	NC
Boron, Total (s)	ug/L		65261	65281	ND(3.37)	ND(3.37)	ND(3.37)	NC
Boron, Total (s)	ug/L		65269	65285	ND(3.37)	ND(3.37)	ND(3.37)	NC
Boron, Dissolved (s)	ug/L		65261	65281	ND(3.37)	ND(3.37)	ND(3.37)	NC
Boron, Dissolved (s)	ug/L		65269	65285	ND(3.37)	ND(3.37)	ND(3.37)	NC
Cadmium, Total	ug/L	P118	65261	65281	ND(0.446)	ND(0.446)	ND(0.446)	NC
Cadmium, Total	ug/L	P118	65269	65285	ND(0.446)	ND(0.446)	ND(0.446)	NC
Calcium, Total (e) (s)	ug/L		65261	65281	7,290	7,190	7,240	1.4
Calcium, Total (e) (s)	ug/L		65269	65285	12,900	13,000	13,000	0.77
Calcium, Dissolved (e) (s)	ug/L		65261	65281	7,100	7,070	7,090	0.42
Calcium, Dissolved (e) (s)	ug/L		65269	65285	13,200	12,700	13,000	3.9
Chromium, Total	ug/L	P119	65261	65281	ND(1.68)	ND(1.68)	ND(1.68)	NC
Chromium, Total	ug/L	P119	65269	65285	ND(1.68)	ND(1.68)	ND(1.68)	NC
Chromium, Dissolved	ug/L	P119	65261	65281	ND(1.68)	ND(1.68)	ND(1.68)	NC
Chromium, Dissolved	ug/L	P119	65269	65285	ND(1.68)	ND(1.68)	ND(1.68)	NC
Cobalt, Total	ug/L		65261	65281	ND(0.914)	ND(0.914)	ND(0.914)	NC
Cobalt, Total	ug/L		65269	65285	ND(0.914)	ND(0.914)	ND(0.914)	NC
Cobalt, Dissolved (s)	ug/L		65261	65281	1.00	ND(0.914)	< 0.957	NC

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Cobalt, Dissolved (s)	ug/L		65269	65285	ND(0.914)	ND(0.914)	ND(0.914)	NC
Copper, Total (e) (s)	ug/L	P120	65261	65281	10.1	11.0	10.6	8.5
Copper, Total (e) (s)	ug/L	P120	65269	65285	9.00	8.40	8.70	6.9
Copper, Dissolved (e) (s)	ug/L	P120	65261	65281	8.70	8.70	8.70	0.0
Copper, Dissolved (e) (s)	ug/L	P120	65269	65285	7.20	7.20	7.20	0.0
Iron, Total (e) (s)	ug/L		65261	65281	376	375	376	0.27
Iron, Total (e) (s)	ug/L		65269	65285	364	369	367	1.4
Iron, Dissolved (e)	ug/L		65261	65281	354	358	356	1.1
Iron, Dissolved (e)	ug/L		65269	65285	363	351	357	3.4
Lead, Total (e)	ug/L	P122	65261	65281	ND(3.08)	ND(3.08)	ND(3.08)	NC
Lead, Total (e)	ug/L	P122	65269	65285	ND(3.08)	ND(3.08)	ND(3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65261	65281	ND(3.08)	ND(3.08)	ND(3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65269	65285	ND(3.08)	ND(3.08)	ND(3.08)	NC
Magnesium, Total (s)	ug/L		65261	65281	1,500	1,470	1,490	2.0
Magnesium, Total (s)	ug/L		65269	65285	1,990	2,010	2,000	1.0
Magnesium, Dissolved (e) (s)	ug/L		65261	65281	1,460	1,460	1,460	0.0
Magnesium, Dissolved (e) (s)	ug/L		65269	65285	2,050	1,980	2,020	3.5
Manganese, Total (e) (s)	ug/L		65261	65281	12.3	12.1	12.2	1.6
Manganese, Total (e) (s)	ug/L		65269	65285	18.0	18.2	18.1	1.1

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Manganese, Dissolved (e) (s)	ug/L		65261	65281	14.2	12.5	13.4	13
Manganese, Dissolved (e) (s)	ug/L		65269	65285	19.1	19.5	19.3	2.1
Mercury, Total (s)	ug/L	P123	65261	65281	ND(0.017)	ND(0.017)	ND(0.017)	NC
Mercury, Total (s)	ug/L	P123	65269	65285	ND(0.017)	0.310	< 0.164	NC
Mercury, Dissolved (s)	ug/L	P123	65261	65281	0.250	0.290	0.270	15
Mercury, Dissolved (s)	ug/L	P123	65269	65285	0.270	0.390	0.330	36
Molybdenum, Total	ug/L		65261	65281	ND(1.50)	ND(1.50)	ND(1.50)	NC
Molybdenum, Total	ug/L		65269	65285	ND(1.50)	ND(1.50)	ND(1.50)	NC
Nickel, Total (s)	ug/L	P124	65261	65281	23.9	23.7	23.8	0.84
Nickel, Total (s)	ug/L	P124	65269	65285	14.2	15.0	14.6	5.5
Nickel, Dissolved (s)	ug/L	P124	65261	65281	23.6	23.3	23.5	1.3
Nickel, Dissolved (s)	ug/L	P124	65269	65285	14.8	15.0	14.9	1.3
Selenium, Total	ug/L	P125	65261	65281	ND(0.572)	0.600	< 0.586	NC
Selenium, Total	ug/L	P125	65269	65285	0.720	0.640	0.680	12
Selenium, Dissolved	ug/L	P125	65261	65281	ND(0.572)	0.640	< 0.606	NC
Selenium, Dissolved	ug/L	P125	65269	65285	0.810	0.800	0.805	1.2
Silver, Total	ug/L	P126	65261	65281	ND(1.28)	ND(1.28)	ND(1.28)	NC
Silver, Total	ug/L	P126	65269	65285	ND(1.28)	ND(1.28)	ND(1.28)	NC
Sodium, Total (e) (s)	ug/L		65261	65281	94,800	92,300	93,600	2.7

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Sodium, Total (e) (s)	ug/L		65269	65285	88,700	89,400	89,100	0.79
Sodium, Dissolved (e) (s)	ug/L		65261	65281	91,400	90,900	91,200	0.55
Sodium, Dissolved (e) (s)	ug/L		65269	65285	90,600	87,300	89,000	3.7
Thallium, Total (s)	ug/L	P127	65261	65281	ND(0.009)	ND(0.009)	ND(0.009)	NC
Thallium, Total (s)	ug/L	P127	65269	65285	ND(0.009)	ND(0.009)	ND(0.009)	NC
Thallium, Dissolved	ug/L	P127	65261	65281	ND(0.009)	ND(0.009)	ND(0.009)	NC
Thallium, Dissolved	ug/L	P127	65269	65285	ND(0.009)	ND(0.009)	ND(0.009)	NC
Tin, Total	ug/L		65261	65281	ND(3.45)	ND(3.45)	ND(3.45)	NC
Tin, Total	ug/L		65269	65285	ND(3.45)	ND(3.45)	ND(3.45)	NC
Tin, Dissolved	ug/L		65261	65281	ND(3.45)	ND(3.45)	ND(3.45)	NC
Tin, Dissolved	ug/L		65269	65285	ND(3.45)	ND(3.45)	ND(3.45)	NC
Titanium, Total (e)	ug/L		65261	65281	ND(0.253)	ND(0.253)	ND(0.253)	NC
Titanium, Total (e)	ug/L		65269	65285	ND(0.253)	ND(0.253)	ND(0.253)	NC
Titanium, Dissolved (e)	ug/L		65261	65281	ND(0.253)	0.380	< 0.317	NC
Titanium, Dissolved (e)	ug/L		65269	65285	0.340	ND(0.253)	< 0.297	NC
Vanadium, Total	ug/L		65261	65281	ND(0.679)	ND(0.679)	ND(0.679)	NC
Vanadium, Total	ug/L		65269	65285	ND(0.679)	ND(0.679)	ND(0.679)	NC
Vanadium, Dissolved	ug/L		65261	65281	ND(0.679)	ND(0.679)	ND(0.679)	NC
Vanadium, Dissolved	ug/L		65269	65285	ND(0.679)	ND(0.679)	ND(0.679)	NC

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-9) (b)	Duplicate Effluent from Treatment (SP-10) (b)	Average	Relative Percent Difference
Yttrium, Total	ug/L		65261	65281	ND(0.222)	ND(0.222)	ND(0.222)	NC
Yttrium, Total	ug/L		65269	65285	ND(0.222)	ND(0.222)	ND(0.222)	NC
Zinc, Total (e) (s)	ug/L	P128	65261	65281	553	545	549	1.5
Zinc, Total (e) (s)	ug/L	P128	65269	65285	320	346	333	7.8
Zinc, Dissolved (e) (s)	ug/L	P128	65261	65281	536	532	534	0.75
Zinc, Dissolved (e) (s)	ug/L	P128	65269	65285	329	316	323	4.0
Semivolatile Organics								
Bis(2-ethylhexyl)phthalate	ug/L	P066	65265	65283	ND(10.0)	ND(10.0)	ND(10.0)	NC
Bis(2-ethylhexyl)phthalate	ug/L	P066	65277	65289	ND(10.0)	ND(10.0)	ND(10.0)	NC
Phenanthrene	ug/L	P081	65265	65283	ND(10.0)	ND(10.0)	ND(10.0)	NC
Phenanthrene	ug/L	P081	65277	65289	ND(10.0)	ND(10.0)	ND(10.0)	NC
Phenol	ug/L	P065	65265	65283	ND(10.0)	ND(10.0)	ND(10.0)	NC
Phenol	ug/L	P065	65277	65289	ND(10.0)	ND(10.0)	ND(10.0)	NC

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4

Field Duplicate Analytical Results for Pathogen Indicators, HEM/SGT-HEM, Volatile Organics, and Dioxins and Furans in Incinerator Ash, Holland America Veendam

Field duplicate analytical results for pathogen indicators, HEM/SGT-HEM, volatile organics, and dioxins and furans in incinerator ash. Field duplicate samples for these analytes were collected sequentially from the same source, stored and analyzed independently. See Figure 2-2 for the sampling point locations. Also listed are the average result and relative percent difference calculated for each duplicate pair. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Waste Stream	Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original	Duplicate	Average	Relative Percent Difference
Influent to Treatment (SP-6/7) (b)	**Pathogen Indicators**								
	E. coli	MPN/100 mL		65224	65310	> 2,420,000	75,900	> 1,250,000	NC
	Enterococci	MPN/100 mL		65224	65310	> 2,420,000	201,000	> 1,310,000	NC
	Fecal Coliform	CFU/100 mL		65224	65310	14,500,000	3,600,000	9,050,000	120
	Classical Pollutants								
	Hexane Extractable Material (HEM)	mg/L		65227	65228	127	131	129	3.1
	Hexane Extractable Material (HEM)	mg/L		65231	65232	154	174	164	12
	Silica Gel Treated HEM (SGT-HEM)	mg/L		65227	65228	48.0	21.0	34.5	78
	Silica Gel Treated HEM (SGT-HEM)	mg/L		65231	65232	12.0	17.0	14.5	34
Influent to UV Disinfection (SP-8) (b)	**Pathogen Indicators**								
	E. coli	MPN/100 mL		65259	65304	75.4	77.1	76.3	2.2
	Enterococci	MPN/100 mL		65259	65304	60.8	35.4	48.1	53
	Fecal Coliform	CFU/100 mL		65259	65304	18.2	8.18	13.2	76

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4 (Continued)

Waste Stream	Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original	Duplicate	Average	Relative Percent Difference
Effluent from Treatment (SP-9/10) (b)	**Pathogen Indicators**								
	E. coli	MPN/100 mL		65264	65302	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65267	65303	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65276	65311	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65279	65305	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65261	65281	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65265	65283	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65273	65287	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65274	65288	ND(1.00)	ND(1.00)	ND(1.00)	NC
	E. coli	MPN/100 mL		65277	65289	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65264	65302	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65267	65303	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65276	65311	1.00	1.00	1.00	0.0
	Enterococci	MPN/100 mL		65279	65305	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65261	65281	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65265	65283	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65273	65287	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Enterococci	MPN/100 mL		65274	65288	5.10	ND(1.00)	< 3.05	NC

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4 (Continued)

Waste Stream	Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original	Duplicate	Average	Relative Percent Difference
Effluent from Treatment (SP-9/10) (b)	Enterococci	MPN/100 mL		65277	65289	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65264	65302	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65267	65303	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65276	65311	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65279	65305	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65261	65281	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65265	65283	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65273	65287	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65274	65288	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Fecal Coliform	CFU/100 mL		65277	65289	ND(1.00)	ND(1.00)	ND(1.00)	NC
	Classical Pollutants								
	Hexane Extractable Material (HEM)	mg/L		65269	65270	ND(5.00)	ND(5.00)	ND(5.00)	NC
	Hexane Extractable Material (HEM)	mg/L		65273	65274	ND(5.00)	ND(6.00)	ND(5.50)	NC
	Hexane Extractable Material (HEM)	mg/L		65277	65278	ND(6.00)	ND(6.00)	ND(6.00)	NC
	Silica Gel Treated HEM (SGT-HEM)	mg/L		65269	65270	ND(5.00)	ND(5.00)	ND(5.00)	NC
	Silica Gel Treated HEM (SGT-HEM)	mg/L		65273	65274	ND(5.00)	ND(6.00)	ND(5.50)	NC
	Silica Gel Treated HEM (SGT-HEM)	mg/L		65277	65278	ND(6.00)	ND(6.00)	ND(6.00)	NC

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4 (Continued)

Waste Stream	Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original	Duplicate	Average	Relative Percent Difference
Effluent from Treatment (SP-9/10) (b)	**Volatile Organics**								
	Tetrachloroethene	ug/L	P085	65265	65283	21.7	53.0	37.4	84
	Tetrachloroethene	ug/L	P085	65269	65285	39.4	56.0	47.7	35
	Trichloroethene	ug/L	P087	65265	65283	ND(10.0)	ND(10.0)	ND(10.0)	NC
	Trichloroethene	ug/L	P087	65269	65285	ND(10.0)	ND(10.0)	ND(10.0)	NC
Incinerator Ash (SP-13/14) (b)	**Dioxins and Furans**								
	1,2,3,4,6,7,8-HpCDD	pg/g		65293	65294	43.9	340	192	150
	1,2,3,4,6,7,8-HpCDF	pg/g		65293	65294	193	3,580	1,890	180
	1,2,3,4,7,8,9-HpCDF	pg/g		65293	65294	15.5	219	117	170
	1,2,3,4,7,8-HxCDD	pg/g		65293	65294	ND(10.0)	13.6	<11.8	NC
	1,2,3,4,7,8-HxCDF	pg/g		65293	65294	43.7	332	188	150
	1,2,3,6,7,8-HxCDD	pg/g		65293	65294	6.12	28.8	17.5	130
	1,2,3,6,7,8-HxCDF	pg/g		65293	65294	43.3	331	187	150
	1,2,3,7,8,9-HxCDD	pg/g		65293	65294	9.34	49.0	29.2	140
	1,2,3,7,8,9-HxCDF	pg/g		65293	65294	ND(10.0)	12.4	<11.2	NC
	1,2,3,7,8-PeCDD	pg/g		65293	65294	ND(10.0)	6.40	<8.20	NC
	1,2,3,7,8-PeCDF	pg/g		65293	65294	29.0	55.7	42.4	63
	2,3,4,6,7,8-HxCDF	pg/g		65293	65294	65.8	787	426	170

(a) Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-8 for source water results.
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit, or because one or both sample results is flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4 (Continued)

Waste Stream	Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original	Duplicate	Average	Relative Percent Difference
Incinerator Ash (SP-13/14) (b)	2,3,4,7,8-PeCDF	pg/g		65293	65294	53.4	206	130	120
	2,3,7,8-TCDD	pg/g		65293	65294	1.63	1.37	1.50	17
	2,3,7,8-TCDF	pg/g		65293	65294	37.6	32.8	35.2	14
	Octachlorodibenzo-p-dioxin	pg/g		65293	65294	73.4	780	427	170
	Octachlorodibenzofuran	pg/g		65293	65294	63.8	1,420	742	180

(a) - Sample numbers identify corresponding analytical results in Appendices A-1 and A-2.
(b) - Sampling point location; see Figures 2-1 and 2-2.
NC - Not calculated because one or both of the sample results is less than and/or greater than the laboratory detection limit.
ND - Not detected (number in parenthesis is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as “>” because the sample was not diluted sufficiently.